PATENT ABSTRACTS OF JAPAN

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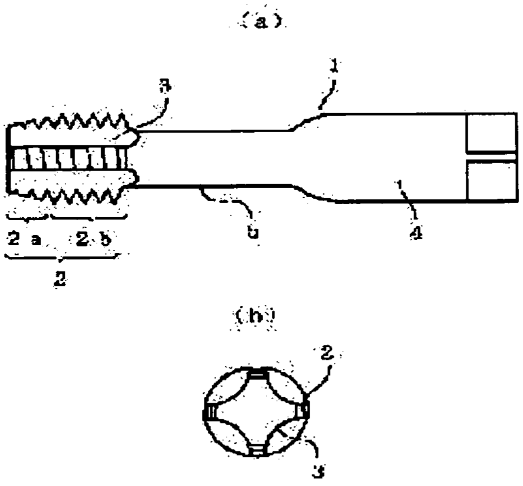
(54) TAP

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a tap having a shape which is formed so as to make cutting resistance small in screw hole boring, and the shape enabling effective elimination of swarf, and yields resistivity against breakage.

SOLUTION: A cutting edge part is formed by a chamfer part of a incomplete thread, and a complete thread part of not less than 4 piches and not more than 6 piches. The cutting edge is coated with a hard film such as a diamond film or a diamantine carbon film, and the cutting edge part is divided circumferentially by a plurality of slots. Also, at a rear end side of the cutting edge part, a minor diameter part which is smaller than a minor diameter of the complete thread part is made. The minor diameter part is not less than 45% of a thread ridge diameter of the complete thread part. Furthermore, as an another shape of the rear end side of the cutting edge part, a screw shaped run off which is continuous with the complete thread part is made, and is tapered so as to become the diameter smaller as parting from the cutting edge part.



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CLAIMS

[Claim(s)]
[Claim 1] The tap which has the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead, and four or more pitch the complete thread of six or less pitch, the hard film covered by the front face of the aforementioned cutting-edge section at least, and two or more slots which divide the aforementioned cutting-edge section in a circumferencial direction.
[Claim 2] The tap according to claim 1 characterized by preparing the thin diameter section of under the minor diameter of the aforementioned complete thread in the back end side of the aforementioned cutting-edge section.
[Claim 3] The aforementioned thin diameter section is a tap according to claim 2 characterized by being 45% or more of the screw thread diameter of the aforementioned complete thread.
[Claim 4] The tap according to claim 1 to 3 characterized by having the shape of a taper to which a path becomes small, so that the roll off of the screw-thread configuration which continues from the aforementioned complete thread is prepared in the back end side of the aforementioned cutting-edge section and it separates from the cutting-edge section.
[Claim 5] The tap according to claim 1 to 4 by which the amount of recess of the cutting edge of the aforementioned bevel lead is characterized by being 15% or less of the diameter of a tap 2% or more at a 27-degree point behind [hand-of-cut] a cutting edge from the start point of recess formation.
[Claim 6] The tap according to claim 1 to 5 by which the amount of recess of the cutting edge of the aforementioned complete thread is characterized by being 15% or less of the diameter of a tap 2% or more at a 27-degree point behind [hand-of-cut] a cutting edge from the start point of recess formation.
[Claim 7] The aforementioned hard film is a tap according to claim 1 to 6 characterized by being a diamond film or a diamond-like carbon film.
[Claim 8] The thickness of the aforementioned diamond film is a tap according to claim 7 characterized by being 5-20 micrometers.
[Claim 9] The thickness of the aforementioned diamond-like carbon film is a tap according to claim 7 characterized by being 1-20 micrometers.
[Claim 10] The tap according to claim 1 to 9 characterized by being a tap for cutting by attaching in the thread cutting equipment which has a full synchronous feed function.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to a suitable tap to process an unscrapable material like especially the composite material of a metal and ceramics about the tap for processing a female screw.
[0002]
[Description of the Prior Art] Various new materials are developed in recent years, and many things which serve as an unscrapable material when performing cutting are used. For example, the metal machine composite material (it is hereafter described as MMC) which is the composite material of a metal and ceramics is raised as an example of an unscrapable material. It is expected that this material is broadly used compared with the conventional metallic material as a material of precision mechanical equipments, such as semiconductor fabrication machines and equipment, and a machine tool, a liquid crystal manufacturing installation, or equipment since a lightweight top and rigidity are high. A tap is used as well as the usual metallic material when carrying out tapped hole processing to such a material. Usually, about 20-30 pitches of complete threads of the portion whose tap is a cutting edge are prepared. However, in above MMC, although a ceramic particle distributes therefore, the tool wear by this ceramic particle is remarkable, and is the material called especially unscrapable material. Therefore, tapped hole processing was not easy, either and it also often generated it that a cutting force becomes large by tool wear, and a tap breaks.
[0003] By making an aluminium alloy into a matrix material, MMC distributes ceramic particles, such as SiC, aluminum2O3, and AlN, in this, and has some in which much pores exist. Although the drill performed prepared-hole processing before performing processing by the tap, the ceramic particle was distributing MMC as mentioned above, and since the hardness difference of a ceramic particle and a matrix material was large, it also often happened that a prepared hole bends. Thus, when tapped hole processing was performed to the crooked prepared hole by the tap, the force in which it bent a tap was applied and the problem of being further easy to break occurred.
[0004]
[Problem(s) to be Solved by the Invention] There is a tap indicated by JP,11-221716,A as a tap for performing tapped hole processing to MMC. This tap consists of a bevel lead whose cutting-edge section is an incomplete thread, and a complete thread in which the one or more pitch cutting edge of three or less pitch was formed, and covers a diamond film in this cutting-edge section. About the thickness of this diamond film, it is supposed by about about 2-3 micrometers that it is good.
[0005] However, even if it was the above taps, it went out and the chip bit to the complete thread depending on the configuration of a cutting part, and the cutting force may have become large. That is, the chip bit between workpieces and there was a possibility that a lump cutting force might become large and might break, so that the length (land width) of the flank of a cutting edge became long. Moreover, since there was almost no interference of the portion and roll off which processing of a workpiece finished when the prepared hole leans [the complete thread] in about three pitches, there was a problem to which a tap inclines more than required and a process tolerance falls.
[0006] this invention proposes the tap which can discharge a chip smoothly and which cannot break easily, when solving the above troubles and carrying out tapped hole processing of an unscrapable material like MMC.
[0007]
[Means for Solving the Problem] The 1st feature of the tap of this invention is having the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead, and four or more pitch the complete thread of six or less pitch, the hard film covered by the front face of the aforementioned cutting-edge section at least, and two or more slots which divide the aforementioned cutting-edge section in a circumferencial direction.
[0008] As the 2nd feature, it is having prepared the thin diameter section of under the minor diameter of the aforementioned complete thread in the back end side of the aforementioned cutting-edge section.

[0009] As the 3rd feature, the aforementioned thin diameter section is having carried out to 45% or more of the screw thread diameter of the aforementioned complete thread.

[0010] Moreover, a path is having considered as the shape of a taper which becomes small, so that the roll off of the screw-thread configuration which continues from the aforementioned complete thread is prepared as feature that the configuration by the side of the back end of the aforementioned cutting-edge section is another and it separates from the cutting-edge section.

[0011] It is having made the amount of recess of the cutting edge of the aforementioned bevel lead into 15% or less of the diameter of a tap 2% or more at the 27-degree point as the 4th feature behind [hand-of-cut] the cutting edge from the start point of recess formation. About this amount of recess, the amount of recess is made into 15% or less 2% or more at a 27 degrees (alpha of drawing 4) point to the hand of cut of a cutting edge to back from the start point in which recess is formed as shown in drawing 4 . Considering as the 27-degree point here selects a 27-degree point as a position where it is necessary to specify the amount of recess in, and it tends [comparatively] to measure a position since a size changes with measuring points.

[0012] It is having made the amount of recess of the cutting edge of the aforementioned complete thread into 15% or less of the diameter of a tap 2% or more at the 27-degree point as the 5th feature behind [hand-of-cut] the cutting edge from the start point of recess formation.

[0013] As the 6th feature, it is having made the aforementioned hard film into the diamond film or the diamond-like carbon film.

[0014] As the 7th feature, it is having set thickness of the aforementioned diamond film to 5-20 micrometers. Moreover, apart from this, when the aforementioned diamond-like carbon film is prepared, it is having set this thickness to 1-20 micrometers.

[0015] It is having considered as the tap for cutting by attaching in the thread cutting equipment which has a full synchronous feed function as the 8th feature. A full synchronous feed function is a function controlled to send by one lead to tap 1 rotation.

[0016]

[Embodiments of the Invention] As the cutting-edge section, the bevel lead of an imperfect configuration is prepared at a nose of cam, and, as for the tap of this invention, the completeness screw-thread Yamagata-like complete thread is prepared succeeding this. A cutting force can be reduced by making the complete thread into four or more-pitch six or less pitch, and shortening a complete thread in this way. Moreover, in order that a tap may incline slightly according to the configuration of a prepared hole since the complete thread is short even if the prepared hole has turned at a few, the force with a tap impossible for is not applied, but it is hard to break. In addition, as a material of a base material, cemented carbide and high-speed steel are suitable.

[0017] The cutting-edge section is divided by the slot in the circumferencial direction, and two or more slots are prepared. About the number of a slot, it is desirable to make [many / that the path of a tap becomes large / so] it. Since the length (land width) of the flank of a cutting edge can be shortened and a chip can be smoothly discharged through a slot by doing in this way, between Yamabe of a cutting edge, and a workpiece, that a chip gnaws decreases and a cutting force can be reduced. Moreover, the hard film is formed in the cutting-edge section.

[0018] The thin diameter section of a path smaller than the minor diameter of a complete thread is prepared in the back end side of the cutting-edge section. Although this thin diameter section is good also as a fixed path which does not have the screw thread, when making it the shape of a taper so that it separated from the cutting edge, and a path might become thin and the prepared hole has bent, even if a tap inclines, a workpiece does not interfere in a thin diameter section and a cutting force does not become large. In addition, as for this thin diameter section, it is desirable to make the portion of the diameter of a narrow into 45% or more of the screw thread diameter of a complete thread most from a viewpoint of the intensity of a tap.

[0019] As another configuration by the side of the back end of the cutting-edge section, it ****s so that it may continue from the complete thread of the cutting-edge section, it considers as a configuration, and let a mountain and a minor diameter be taper-like roll off so that you may become so small that it goes out and separates from a cutting part. It prevents that a tap inclines more than required, and can prevent that a process tolerance falls because the portion which processing of a workpiece finished with doing in this way while preventing that a cutting force became large, when a tap inclined, and roll off interfere each other.

[0020] Although recess is generally formed to a cutting edge, as shown in drawing 4 (a), by the tap of this invention, the angle alpha makes the amount X of recess of the cutting edge of a bevel lead 15% or less of the diameter of a tap 2% or more at the point which is 27 degrees behind [hand-of-cut] the cutting edge from the start point 8 of recess formation. Although the amount of recess generally formed is made into about 0.5 - 1% of a tap diameter at the above-mentioned point, by the tap of this invention, it can prevent that make contact of **-ed material and a cutting edge into the minimum by escaping and enlarging an amount, make a cutting force small, and a base material breaks. It is a size required in order that carrying out to 2% or more of the diameter of a tap may make small a touch area with **-ed material and it may reduce a cutting force, and when using it with thread cutting equipment without a full synchronous feed function etc., may be 15% or less for preventing that the precision of the female screw processed in order that the rotational speed and the feed rate of a tap might not synchronize becomes bad.

[0021] Furthermore, if the recess of the same amount of recess also as the cutting edge of a complete thread is formed, it can prevent that a base material breaks more.

[0022] As a hard film formed in the cutting-edge section, it is desirable to prepare a diamond film or a diamond-like carbon film. A diamond film is desirable, when it suppresses wear of a cutting edge, and is effective in raising the life of a tap and abrasion resistance is taken into consideration, while this reduces a cutting force, when processing an unscrapable material. In addition, as for the material of a base material, cemented carbide is suitable when forming a diamond film or a diamond-like carbon film.

[0023] This thickness is set to 5-20 micrometers when preparing a diamond film. You may be 5 micrometers or more for a crack tending to enter during processing, since membranous intensity is weak when membranous thickness is thin, and resulting in exfoliation from there. Moreover, it is because it will be in the state where it was dotted with the particle of a diamond and does not become a film, even if it is going to form a less than 5-micrometer film depending on the membranous formation method. Although it is also possible to form a less than 5-micrometer diamond film by performing coitus with diamond powder etc., since the adhesion force with a base material becomes weak by this method and a diamond film becomes easy to separate, in a tool like this invention, it is unsuitable. If thicker than this, when it can become completely large and the operation as an edge will fall R of the edge of a blade of the cutting-edge section, you may be 20 micrometers or less for a film becoming easy to separate with the residual stress produced according to the difference of the coefficient of thermal expansion of a base material and a diamond film in case a diamond film is formed.

[0024] This thickness is set to 1-20 micrometers when preparing a diamond-like carbon film. If it is required to be referred to as 1 micrometers or more in order to prevent preventing that a base material is exposed and to maintain the cutting-edge function as a cutting tool at worst, when these films are worn out by cutting, and it is thicker than this to be referred to as 20 micrometers or less When it can become completely large and the operation as an edge falls R of the edge of a blade of the cutting-edge section, it is for a film to become easy to separate with the residual stress produced according to the difference of the coefficient of thermal expansion of a base material and a film in case a diamond-like carbon film is formed.

[0025] It is suitable to use the above taps for the use which cuts by attaching in the thread cutting equipment which has a full synchronous feed function. The problem that are hard to break by using the tap considered as the above composition even when the prepared hole has bent slightly, and a chip bites and breaks is also prevented. Furthermore, when **-ed material is MMC, especially the effect of breakage prevention becomes large.

[0026]

[Example] The tap of the 1st example of this invention is shown in drawing 1 . The tap of M3 is mentioned as an example in this example, and it explains it. What processed the configuration of drawing 1 was prepared using cemented carbide as a material of a base material 4. The cutting-edge section 2 is formed in the point of a base material 4. To the shaft of a tap, this cutting-edge section 2 makes four pieces the threads per inch of 10 degrees and complete-thread 2b, and the rake angle made the angle of four pieces and bevel-lead 2a -3 degrees - -5 degrees for the threads per inch of bevel-lead 2a. The path of the mountain of a complete thread is 3.00mm, and a minor diameter is 2.40mm. The slot 3 which divides the cutting-edge section 2 makes a straight-line-like thing four, and is dividing the cutting-edge section into the circumferencial direction equally. It is about 1.13mm, the circumferencial direction length, i.e., the land width, per piece of a complete thread divided into four. The thin diameter section 5 with a diameter of 2.10mm is formed in the back end side of the cutting-edge section 2 covering a length of 10.00mm. The diamond film was formed in this cutting-edge section 2 by the vapor phase synthetic method, and thickness was set to about 15 micrometers. In addition, the amount of recess of the cutting edge of a bevel lead and a complete thread is made into the amount of recess of the cutting edge of a general tap, and is 0.03mm at a 27-degree point behind [hand-of-cut] a cutting edge from the start point of recess formation.

[0027] The tap of the 2nd example is shown in drawing 2 . This makes a taper configuration the thin diameter section 5 of the tap of the 1st example, and it is ****, so that it separates from the cutting-edge section 2. 2.35mm and the diameter of the minimum set the overall diameter of a thin diameter section to 2.10mm. About the configurations and sizes other than a thin diameter section, it is the same as the 1st example.

[0028] The tap of the 3rd example is shown in drawing 3 . This prepares the roll off made into the taper-like screw-thread configuration instead of the thin diameter section 5 of the tap of the 2nd example, and it is ****, so that a mountain and a valley separate from the cutting-edge section 2. For the diameter of maximum Daisen of roll off 6, 2.95mm and the maximum root diameter are [2.70mm and the minimum root diameter of 2.35mm and the diameter of the maximum hill] 2.10mm.

[0029] As the 4th example, what enlarged the amount of recess of the tap of the 1st example was prepared. The amount of recess of the cutting edge of a bevel lead and a complete thread was set to 0.06mm (2% of the diameter of a tap) at the 27-degree point behind [hand-of-cut] the cutting edge from the start point of recess formation.

[0030] The tap which set to 3 micrometers thickness of the diamond film which makes three the slot 3 which divides two pieces and the cutting-edge section 2, and forms the threads per inch of complete-thread 2b in the cutting-edge section 2 as an example of comparison was prepared. About the configuration and size except having described here, it considered as the same thing as the 1st example of this invention.

[0031] MMC material was used for the material to process as an example of an unscrapable material, and composition of MMC material used for it what contains 30% of SiC particle in aluminum. Tapped hole processing was performed using four kinds of above-mentioned taps, and the state where a tap broke was tested. It was processed until the tap broke using each tap every five, and the processible number of holes was examined. The result of these examinations is shown in Table 1.

[0032]

[Table 1]

	折れるまでの平均加工穴数
実施例１	４２０
実施例２	３５０
実施例３	３００
実施例４	４８０
比較例	９０

[0033] As shown in Table 1, the result of being easy to break came out of the tap of the example of comparison to what the tap of this invention cannot break in easily. From the above thing, the tap of this invention cannot break easily and leads to the reinforcement of a tap.

[0034] And this invention is not limited to these examples. [the example explained above] [instantiation] Moreover, it is not what was indicated by the scale which was emphasizing the feature portion in order to make the feature of this invention easy to understand, and not necessarily followed this invention about drawing.

[0035]

[Effect of the Invention] As explained above, when ****ing and processing an unscrapable material, even if the prepared hole has turned at the tap of this invention slightly, it cannot break easily, and the long tap of a life is obtained.

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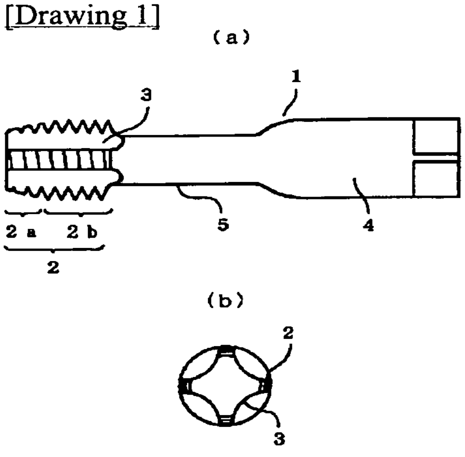
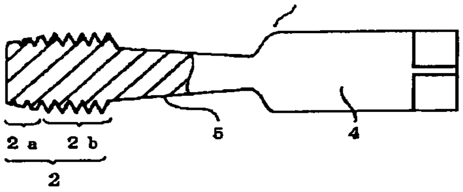
DRAWINGS

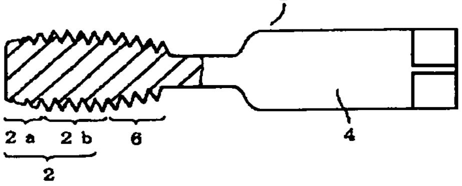
[Drawing 1]



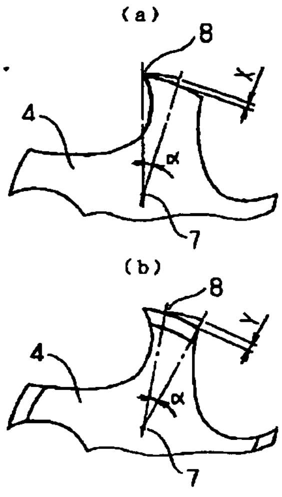
[Drawing 2]



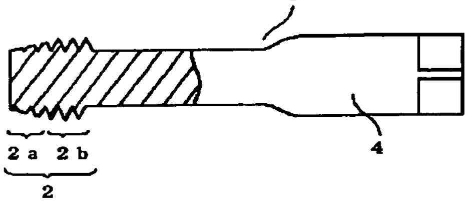
[Drawing 3]



[Drawing 4]



[Drawing 5]



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